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Interplay of policy experimentation and institutional change in sustainability transitions: The case of mobility as a service in Finland

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ABSTRACT

While experimentation is at the heart of sustainability transitions, little attention has been paid to *policy experimentation* and its effects in advancing transitions. Drawing on the literatures on policy experimentation and institutional change in the context of sustainability transitions, we analyse an in-depth case study of the development of Mobility as a Service (MaaS) in Finland – one of the first countries globally to advance MaaS by government support. Our findings show how a potentially disruptive innovation, MaaS, can be traced back to a longer process of administrative reorientation and restructuring, i.e. gradual transformation in institutions, and has benefitted from cycles of policy experimentation, combined with the sequencing of policy strategies and further changes in the policy mix. Administrative restructuring has enabled policy experimentation that has led - via new vision building, networking and learning - to major regulatory change allowing market creation for MaaS. We conclude that the dynamics of policy mixes in transitions are influenced by short-term policy experimentation and long-term institutional change. More generally, institutional change is vital for enabling a favourable context for policy experimentation in sustainability transitions that in turn provides cognitive and normative learning to inform further institutional change.

1. Introduction

There have been calls that innovation policy should undergo a paradigm shift, taking environmental sustainability and social equality at its core (Diercks et al., 2019; Weber and Rohracher, 2012). Such transformative innovation policy aims for sustainability transitions via providing directionality and enabling experimentation (Schot and Steinmueller, 2018). Experimentation is a core part of early sustainability transitions research (Hoogma et al., 2002; Raven, 2005) and capacity to foster experimentation has also been argued as one of the key characteristics of innovation policy mixes (Magro and Wilson, 2019). Moreover, governance experimentation in urban contexts is seen necessary for climate change mitigation (e.g. Bulkeley and Castan Broto, 2013; Evans et al., 2016). Yet, more specific experimentation with the design of public policies and associated instruments, here referred to as *policy experimentation*, has not received much attention in the context of sustainability transitions. It has also received little attention in the context of innovation policy (Bravo-Biosca, 2020; Tassey, 2014).

Thus, in this article, for investigating policy experimentation, we will particularly draw on the literature on climate policy experimentation (Bernstein and Hoffmann, 2018; Huitema et al., 2018; Mcfadgen and Huitema, 2018). Climate policy scholars see policy experiments increasingly as mobilisers for desirable societal transformation (Ansell and Bartenberger, 2016; Huitema et al., 2018). For example, Ansell and Bartenberger (2016) identify different 'uses' of experimentation in environmental problem solving, including the encouragement of innovation leading to transitions; designing and evaluating institutional arrangements; and reassuring social and political learnings to mobilise support for sustainability.

Likewise, little attention been paid to how policy experimentation connects to changes in institutions that coevolve with technology and actors in transitions. The connection between policy experimentation and institutional change often remains vague, while there is an expectation that favourable changes prompted by experiments may become institutionalised over time (cf. Turnheim et al., 2018). Therefore, we also explore the interplay of policy experimentation and institutions in this article.

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Disruptive niche innovations can support the transformation of socio-technical systems towards fundamentally improved environmental and social sustainability. In transport and mobility, such sustainable innovations have been called for over a decade (Cohen, 2010; Sandén and Hillman, 2011; van den Bergh et al., 2007), with recent attention to new service- and intelligent transport-based innovations (Audouin and Finger, 2018; Sochor et al., 2015). Here, we aim to investigate the interplay of policy experimentation and institutional change in the context of an in-depth case study of the development of Mobility-as-a-Service (MaaS) in Finland. We are interested in the following research questions: What was the role of the public administration in the development of MaaS in Finland? What kind of policy experimentation influenced this development? How did policy experimentation connect with institutional changes? We end by making broader connections of this interplay to policy mixes in sustainability transitions.

MaaS is a disruptive niche innovation with potential to stimulate a transformation in mobility systems away from privately-owned personal transport. Finland was the first country in the world to launch the MaaS concept officially, with the lead of the Ministry of Transport and Communications, backing it up with major regulatory renewal, the Transport Service Act. The emergence of MaaS traces back to broader institutional and policy developments of the 1990s and early 2000s at the intersection of transport and communications policy.

From the perspective of sustainability transitions, MaaS offers potential for significantly altering mobility systems, if it replaces private car ownership and travel with more sustainable solutions. However, this requires scaling up MaaS innovations and destabilising the private vehicle and combustion engine based mobility system. Research on MaaS is in its early phases, and social science studies on the governance and institutional changes connected to MaaS have been rare. Our study complements this emerging strand of literature (Audouin and Finger, 2018; Smith et al., 2018b) by providing an account of policy experimentation and institutional change influencing MaaS.

The remainder of the article is structured as follows. Section 2 presents a review of the literature on experimentation in transitions, policy experimentation, and institutional change in transitions to inform our analysis. This is followed by a review of MaaS literature in Section 3. Section 4 describes the research method, and Section 5 presents the findings. Section 6 discusses the findings, and Section 7 concludes.

2. Policy experimentation and sustainability transitions

2.1. Experimentation in transitions

Experimentation is a key activity in sustainability transitions, with experimental activities contributing to the development of new niches (Hoogma et al., 2002; Grin et al., 2010). Niches are protected spaces such as specific market or application domains, where disruptive innovations can develop uninfluenced by the selection pressures of the dominating socio-technical system (Kemp et al., 1998). They have been found crucial as building blocks for new socio-technical systems.

The transitions literature describes experiments in multiple ways, ranging from niche-level experimentation in the multi-level perspective (MLP) and strategic niche management (SNM) frameworks (van der Laak et al. 2007; Schot and Geels, 2008), through entrepreneurial experimentation in the context of technological innovation systems (Hekkert et al., 2007), to transition experiments in transition management (Frantzeskaki et al., 2012; Loorbach et al., 2015). The main idea behind experimentation in transitions lies in radical or disruptive novelty, the involvement of new types of actors, and on-the-ground activities feeding into the nurturing of sustainable innovation niches and societal problem solving (Berkhout et al., 2010; Kivimaa et al., 2017; Sengers et al., 2019).

Experimentation advances the processes connected to strategic niche management: shielding niche development from the mainstream selection environment, and nurturing it by articulation of expectations and visions, generating deep learning, and creating new networking around the niche (Raven, 2005; Schot and Geels, 2008; see Table 1). The accumulation of social learning from these experiments is argued to promote systemic innovation (Sengers et al., 2019). Yet, changes have mostly been reported at the level of discourses and their reframing (Kivimaa et al., 2017) such as visions formalised in policy strategy documents.

Bernstein and Hoffmann (2018) describe the potential outcomes of experiments to transitions via three different mechanisms: catalysing normative change; building capacity to act differently by mobilising resources directly or via institutional change; and coalition building. They state that these "mechanisms help to determine whether the changes the experiment promotes will scale up and become entrenched in the targeted system, whether directly because the intervention itself grows, diffuses, and/or becomes institutionalized or because its policies and practices take on a life of their own, spawning further interventions or scaling and entrenching in other ways (changing other institutions, creating new legislation, altering business practices, etc.)" (p. 191). Thus, they view that experiments influence institutional change, while they do not detail how this happens.

Two connected literatures concern 'policy mobility' and 'projectified governance'. The former emphasises how knowledge is actually being transferred in uneven processes of learning, imitation, adaptation and mutation in complex inter-personal and inter-organisational settings (Affolderbach and Schulz, 2016). Institutional changes do not derive from single 'seed-beds' for experimentation (Affolderbach and Schulz, 2016). Moreover, not all experiments become successful in circulating learning broadly, challenging existing regimes or as new institutional arrangements (Torrens et al., 2019; see also Parks, 2019). The complexity of policy mobility means that the influence of experiments is often difficult to separate from other processes. It may be that only some dimensions of an experiment are adopted or create impact (if any): for example, its' technological output, policy relevant output, or actor-network setting, such as a new type of relationship (Turnheim et al., 2018; Parks, 2019).

The latter literature on 'projectified governance' argues that many

Table 1
Processes of strategic niche management and how they connect to experimentation.

SNM process	Connection to experimentation
Articulation of expectations and visions	Different actors participate in projects and experiments based on their expectations, contributing to niche development. Expectations provide direction to learning processes and attract the attention of more actors and resources. This process is successful if more actors began sharing the same expectations, and expectations become more specific, e.g. based on tangible results from experiments. (van der Laak et al., 2007; Schot and Geels, 2008)
Building of social networks	In early niche development, social networks are weak. Networks are built, via experimentation and intermediary activities, to create a constituency behind the niche by facilitating interactions and providing resources. The process is successful when networks are broad, orientated towards deep learning and regular interaction is supported. (van der Laak et al., 2007; Schot and Geels, 2008; Kivimaa, 2014)
Learning on multiple dimensions	Niche development relies on different types of learning, e.g. technical, market, cultural and policy learning, that can be supported via a range of experimentation. This learning needs to go beyond the gathering of facts and data to changes in cognitive frames and assumptions. The process is successful when it connects technological change to societal embedding in local contexts, covers multiple dimensions and is reflexive. (van der Laak et al., 2007; Schot and Geels, 2008)

experiments take a projectified form, meaning that they are bounded in time and resources (Lundin and Söderholm, 1995). Such project-logic may hinder opportunities for learning and broader systemic effects (Torrens and von Wirth, 2021). However, Munck af Rosenschöld (2019) specifies that adaptive projectified governance appears suitable for dealing with complex sustainability challenges. Such an adaptive mode can lead to institutional change, not only by enabling a horizontal transfer of project knowledge, but also through vertical monitoring of project activities, for example, through the coordinating activities of an established organisation. Experimental and project logics differ, however, and experimentation is often taking place in contexts where the project-logic prevails, which creates biases that limit the variety of policy experimentation (Torrens and von Wirth, 2020).

We argue that policy experimentation has been neglected in transition studies, even though transition studies describe some interventions that can fall under policy experimentation, depending on the involvement of the public sector. In innovation policy, policy experimentation can, for example, comprise innovation programmes that open closed collaboration networks and break policy silos (Grillitsch et al., 2019) or contain new designs or new kinds of preparation processes. Other types of policy experiments include, for example, the setting up of 'transition arenas' (Frantzeskaki et al., 2014) to re-direct policymaking; 'policy labs' or policy-related 'urban living labs' (von Wirth et al., 2019). These can enable spaces for new network formation, vision creation or piloting, feeding back into policymaking; or other ways to deviate from the structure of traditional policy instruments and, often bureaucratic, policy processes. Such policy experimentation is needed, because "conventional policy interventions, such as R&D investments or targeted subsidies, will most likely not suffice to initiate and foster sustainability transitions" (von Wirth et al., 2019, p. 230).

2.2. Policy experimentation

Experimentalist governance has emerged as an idea gaining increasing interest in academic literature and public policy. For example, an experimentalist turn has been noted in the governance of climate change drawing partly from transition studies (Turnheim et al., 2018) and broadening innovation policy (Morgan, 2018). In addition, experimentation has received attention in the governance of urban transitions (e.g. Bulkeley and Castan Broto, 2013; Evans et al., 2016).

Sabel and Zeitlin (2012, p. 1) have defined experimentalist governance as "a recursive process of provisional goal-setting and revision based on learning from the comparison of alternative approaches to advancing them in different contexts". Their idea incorporates framework goals, such as 'sustainable forests' or 'good water quality' in combination with local units that have broad discretion how to pursue these goals; regular reporting on the performance from local units subjected to peer review; and periodic revision of goals, metrics and decision-making processes by a widening circle of actors (i.e. learning-by-monitoring). Experimentalist governance is based on deliberation and generation of evidence. This model was developed in response to command-and-control regulation which is argued not to work in a contemporary world that experiences fast-paced changes and problems of implementing fixed rules on the ground (Morgan, 2018). Sabel and Zeitlin's structured approach of experimentalist governance has inspired literature on policy experimentation that adopts both stricter formulations and more informal views on it (Abbott, 2017).

The literature on policy experimentation is argued to lack conceptual clarity, and multiple interpretations of the term exist, ranging from a research method to broader ideas of governance (Huitema et al., 2018). Those with a narrower interpretation focus on 'controlled field-trials', testing, and evidence gathering (Mcfadgen and Huitema, 2018; Turnheim et al., 2018). This view describes policy experiments as interventions that have been formally established as experiments, making analogues with laboratory experiments (Abbott, 2017). Heilmann (2008, p. 3) defines such experimentation as "a purposeful and coordinated activity geared to producing novel policy options that are injected into official policymaking and then replicated on a larger scale, or even formally incorporated into national law". The wider interpretation, adopted in this article, contains perspectives on experimentation as a mechanism for learning-by-doing, novelty creation and transformation (Turnheim et al., 2018). This wider view includes interventions that can formally or informally be described as policy experimentation (Abbott, 2017).

Despite these differences, the narrow and wide conceptualisations share the notion that something new is being tried out (Bernstein and Hoffmann, 2018). Other elements that are frequently shared include a small scale, a temporary nature of the intervention, and learning (Mcfadgen and Huitema, 2018; Tassey, 2014). The small scale can mean a more limited policy scope, geographical area, size of the target group or budget compared to standard policy interventions in a given policy domain. The temporary nature means that the intervention is set for a fixed period after which the intervention is reviewed and, based on this review, continued, modified or terminated. "By characterizing the policy change as experimental (temporary), the potential consequences of undesirable results and thus the associated risks are greatly reduced" (Tassey, 2014, p. 420).

However, it is the third element - learning – that can be seen as the principal idea behind experimentation (Brown and Vergragt, 2008; Tassey, 2014). Ansell and Bartenberger (2016) distinguish two types of learning: *epistemic*, connecting to the scientific understanding of the world, and *political*, learning about changes in the preferences, goals, and commitments of stakeholders. Similarly, McFadgen and Huitema (2017) consider learning in the context of policy experiments to comprise *cognitive* learning (new knowledge and improved structuring of existing knowledge, a deeper understanding of the policy process) and *normative* learning (changes in perspectives, goals, or priorities).

These different forms of learning may feed into, and in some cases shape, institutional change. Mei and Liu (2014) note that several small-scale policy experiments may cumulatively lead to incremental policy changes, while the role of experiments in generating institutional change is uncertain. It is not granted that learning has such influence, because knowledge generated in experiments is but one consideration for policymakers (Huitema et al., 2018). That is, policy experiments are embedded in political dynamics (Huitema et al., 2018) that are too easily ignored (Hoffmann, 2011). In addition, it has been suggested that politicians are typically not interested in learning, truth and reflexivity, and instead are guided by power-seeking and popularity (Morgan, 2018). Moreover, "experiments are infused with political ideas and they suggest that in practice experiments often confirm existing ideas rather than challenge them" (Brodkin and Kaufman, 2000, quoted by Huitema et al., 2018).

Finally, the role of actors is another important dimension. Policy actors can intentionally design new policy interventions (Mei and Liu, 2014), and this may be easier in the context of policy experimentation. Policy experiments are described to face less resistance than full-scale and more permanent policy changes due to their tentative nature, lower costs and smaller scale (Tassey, 2014). Moreover, policy experimentation may reach out to actors that have normally been excluded from public governance processes. In the context of global climate governance, experimentation is often framed as interventions that involve non-state actors and their coordination (Abbott, 2017; Bernstein and Hoffmann, 2018). In transition contexts, this may imply an increased involvement of private sector actors and, in sectoral policy contexts, actors not typically involved in policy processes of the sector in question.

2.3. Institutional change in transitions

Huitema et al. (2018) argue that little is written in policy sciences about how policy experimentation affects institutional change. The study of institutions is an extensive research field with multiple strands

(e.g. historical, sociological and organisational institutionalism) which is receiving increasing attention in transition studies (Andrews-Speed, 2016; Lockwood et al., 2017). Institutional theory is one of the building blocks of the sustainability transitions literature, specifically the MLP, although it remains rather implicit in many empirical studies. Scott's (1995) regulatory, normative and cognitive institutions are associated in the MLP with *rules* that guide actor perceptions and activities (Geels, 2006, 2004; Geels and Schot, 2007). Geels (2004) notes that "existing rules, regimes and institutions… provide constraining and enabling contexts for actors (individual human beings, organisations, groups). Perceptions and (inter)actions of actors and organisations are guided by these rules ('structuration')". Elzen et al. (2012) talk about institutions as formal and informal rules that condition human behaviour and interaction. Recent work confirms socio-technical regimes as the institutional structuring of tangible socio-technical systems (Geels, 2020).

However, so far, the transitions literature has paid limited *explicit* attention to institutional change. Some notable exceptions include Fuenfschilling and Truffer (2016) on institutional work, Fuenfschilling and Binz (2018) on institutional structures and rationalities, and Geels (2020) on neoinstitutional theory. Nonetheless, earlier studies offer some understanding on institutional change, especially in connection to the evolving alternatives to regimes, i.e. niches. More precisely, socio-institutional structures have been noted to form stable backgrounds in the context of socio-technical regimes (Geels, 2010), and socio-institutional dynamics have been used to refer to negotiating rules in evolving socio-technical systems (Geels and Schot, 2007). Such dynamics between actors and rules occur when niches develop and stabilise. That is, new rules are developed around a niche, influencing niche and regime actors' actions ('institutional anchoring' (Elzen et al., 2012); see also 'institutional logics in transitions' (Fuenfschilling and Truffer, 2014)). When niches stabilise, roles and responsibilities become institutionalised (Geels, 2020). "[I]nstitutions regularize behaviour, but at the same time enable agency and change" (Fuenfschilling and Truffer, 2014). However, the stability of institutions can also make it difficult for actors to unlearn and regimes to destabilise, thereby preventing niches to reconfigure regimes.

Recent work has drawn from historical institutionalism in sustainability and energy transitions (Andrews-Speed, 2016; Lockwood et al., 2017; Roberts and Geels, 2019). Its focus is on institutional arrangements and the politics of transitions, while less attention is given to policy learning (Roberts and Geels, 2019). The latter is our interest here, as it links policy experimentation to institutional change in transitions. Thus, in this article, we will link to some key mechanisms in the mainstream institutional change literature. We follow North (1991, p. 97) who defines institutions as "the humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights)." Institutions are also described as building-blocks of social order that integrate collectively enforced expectations with respect to the behaviour of actors or the enactment of activities, including rights and obligations for actors (Streeck and Thelen, 2005).

Correspondingly, institutional change occurs when many actors switch from one logic of action to another (Streeck and Thelen, 2005). This is regarded as the beginning of a new path where the new general orientation of actors operates like a 'meta-rule' (Deeg, 2005). Mahoney and Thelen (2010, p. 8) argue institutions are always exposed to changes, as they "represent compromises or relatively durable though still contested settlements based on specific coalitional dynamics". Streeck and Thelen (2005) identify four classes of institutional change based on processes (incremental or abrupt) and result of change (continuity or discontinuity) (Table 2). From the perspective of sustainability transitions, interesting are 'gradual transformation' that through incremental processes of change lead to discontinuity in institutions, and 'breakdown and replacement' that result in discontinuity from abrupt processes of change. What we can draw from this is that breakdown is not the only mechanism of transformative change, and those that lead in pursuing sustainability transitions can advance gradual transformation instead.

Table 2
Forms of institutional change.

		Result of change	
		Continuity	Discontinuity
Processes of change	Incremental	Reproduction by adaptation	Gradual transformation
	Abrupt	Survival and return	Breakdown and replacement

Source: Streeck and Thelen, 2005.

Streeck and Thelen (2005) also proposed four characterisations of how institutions change: (1) 'displacement' refers to replacing old institutional rules with new ones; (2) 'layering' implies the introduction of new institutional rules, while the old ones are not removed; (3) 'drift' is about formal rules being 'officially' stable but the effects of existing rules alter due to changes in the broader context (in transition terms in the landscape); and (4) 'conversion' means formal rules being stable but their interpretation and implementation (i.e. function) changes. However, these processes do not consider the temporary and small-scale role of learning generated by policy experimentation and how it may lead to more permanent changes in institutions.

2.4. Our conceptual setting: interplay between policy experimentation and institutional change

The importance, albeit hitherto neglected, of connecting experimentation to institutional change has been highlighted in a special issue on institutional change in the context of urban experimentation (Fuenfschilling et al., 2019). It indicated that experimentation and institutions are closely connected, for example, via institutions defining the legitimate forms of experimentation in specific geographical contexts. However, none of the special issue contributions specifically addressed policy experimentation and (formal) institutional change. It is this gap in the nascent literature on experimentation and institutional change in transitions we aim to tackle with our research. Therefore, in the following, we outline our understanding of policy experimentation and formal institutional change, and how they relate to each other in influencing transitions.

First, drawing from Tassey (2014) and McFadgen and Huitema (2018), we define policy experimentation for sustainability transitions as temporary and reflexive policy interventions – both instruments and processes – that contribute to niche development and regime destabilisation by mechanisms of learning (and unlearning), articulation of expectations and visions, and networking. Temporary refers to a short, fixed-term duration set out for the instrument or process at its initiation. Reflexive implies the intention to learn from the experiment and its evaluation, indicating the possibility to revise it during its course. We differentiate between two types of policy experimentation both limited in scale and time: (1) incrementally innovative policy interventions which occur within the boundaries of established innovation policy, including, for example, the testing of new instrument designs or more inclusive target groups for innovation funding - referred to as type 1 (Grillitsch et al., 2019); and (2) more radically innovative policy interventions often falling outside the boundaries of established innovation policy, including, for example, the generation of deep learning from transition arenas or urban living labs - referred to as type 2 (e.g. Loorbach et al., 2015).

Second, policy experimentation is bound by formal and informal institutions which determine who is included or excluded, who does what, how authority is distributed, how decisions are made, what kind of knowledge is generated and how it is transferred (McFadgen and Huitema, 2017). Given our focus on public policy, we concentrate on

formal institutions, described by Streeck and Thelen (2005) as social regimes characterised by stability and including rule makers, formalised rules, rule takers and third-party enforcement.

Formal institutions are typically seen as encompassing policies (for example, in the form of laws) and as regulatory agencies (North, 1991) alongside electoral and political institutions (Lockwood et al., 2017) and, thus, policies may be viewed as a subset of institutions. A more nuanced interpretation may consider that formal institutions and policies overlap when public policies give normatively backed rights and responsibilities to actors other than the policymakers themselves (North, 1991; cf. Streeck and Thelen, 2005). Thus, it would imply those policy strategies, instruments and processes which meet these criteria and have become stabilised as formal institutions. Following this more nuanced line of argument, policy experiments would not classify as institutions when they are initiated but only when they are diffused more broadly or become permanent, i.e. institutionalised. We also regard public administration organisations as institutions "to the extent that their existence and operation become in a specific way publicly guaranteed and privileged, by becoming backed up by societal norms and the enforcement capacities related to them" (Streeck and Thelen, 2005, p. 12). This would include, for example, government departments and ministries and their agencies.

Here we pay attention to how policy experimentation connects with institutional change via the different forms of learning it generates. Fuenfschilling et al., 222) argue that "[*e*]xperiments can contribute to the deinstitutionalisation of dominant, unsustainable configurations" and act as spaces where new institutional environments for novel practices and narratives are created. Further, we are interested in whether formal institutional change may enable or restrict policy experimentation based on the degree to which regulatory frameworks and organisational structures encourage and allow, or discourage and restrict, policy experimentation by policymakers and civil servants. The previous literature suggests that "[*i*]nstitutional settings define the degree and form of experimentation that is deemed legitimate" (Fuenfschilling et al., 2019, p. 225), implying that experiments will be bound by institutional rules (McFadgen and Huitema, 2017).

3. Mobility as a service

Mobility-as-a-service (MaaS) does not refer to a single technology but rather a new way of thinking about how mobility is provided and used. The use of MaaS in the academic literature has been argued to lack conceptual clarity (Audouin and Finger, 2018; Flügge, 2017). According to Smith et al., the understandings of MaaS sit along a spectrum from "a wide range of transport services, from peer-to-peer services… to services that attempt to optimize the connection between personal cars and [public transport]" to more narrow understandings of MaaS as specific 'packaged offerings' with "intermodal planning, booking and payment functionalities, as well as multiple transport modes and mobility packages" (Smith et al., 2018a, p. 2). Our case study is orientated to the latter.

When MaaS is understood in a narrower sense, as packaged offerings combined with intermodal planning, the existence of specific MaaS integrators and operators is required. MaaS integrators "mediate the offerings from several transport service providers (and potentially other suppliers) to MaaS operators through activities such as technical integration, contract management and financial clearing", while MaaS operators "deliver MaaS to end-users by enabling them to seamlessly plan, pay for and execute use of public transport and other transport services, through a single interface" (Smith et al., 2018a, p. 2). The formation of new business models around MaaS has particularly orientated around MaaS operators (Audouin and Finger, 2018; Sochor et al., 2015), while also business models, for example, around shared mobility relate to broader MaaS developments (Cooper et al., 2019; Skeete, 2018).

Utriainen and Pöllänen (2018) reviewed scientific literature on MaaS, finding that the early literature focused on different transport modes and services, findings of pilots, and the expected effects of MaaS. In our review, we found emerging attention since 2018 on the user perspective (Hesselgren et al., 2019) and public governance aspects (Audouin and Finger, 2018; Smith et al., 2019, 2018a, 2018b). Previous research has also explored potential customer markets and consumer behaviour (Sochor et al., 2016; Strömberg et al., 2016) and the configuration of business models for MaaS provision in Sweden (Sochor et al., 2016), Germany (Giesecke et al., 2016) and Finland (Audouin and Finger, 2018).

Research on the governance of past and ongoing MaaS developments has been lacking (Audouin and Finger, 2018), apart from Smith et al. (2019, 2018a, 2018b). The few analyses have focused on the roles of public and private sectors (Smith et al., 2018a) and multi-level governance (Audouin and Finger, 2018). Audouin and Finger (2018) investigated the launch of the WHIM app in Helsinki, and found supportive roles of governance processes, such as the development of a MaaS stakeholder network, launching MaaS initiatives in parallel with one another, lobbying efforts from the local government, a strong shared vision of MaaS pushed by public authorities, and the development of the Transport Service Act. Furthermore, Smith et al. (2018b) found how top-level support and inter-organisational collaboration have influenced Finnish MaaS developments. Our study complements Audouin and Finger (2018) and Smith et al. (2018a, 2018b) by providing a deeper and newer account of the role of public governance by focusing on the role of policy experimentation and institutional change.

4. Methods

We undertook exploratory case study research (Eisenhardt, 1989; Gerring, 2004), examining the process of MaaS development, with a specific focus on public governance activities. Our study included two phases, with time in between to follow up on the development and the impacts of institutional changes on MaaS. Phase I explored the Finnish mobility transition and different niche innovations. MaaS arose in this phase as an emerging niche with substantial potential to change the mobility system, not only in terms of vehicles and fuels but also practices and routines around mobility. MaaS can also potentially connect the more technologically-orientated niches cultivating the use of biofuels and electric vehicles. Phase II examined MaaS specifically and, based on the initial insights emerging from Phase I, focused on the role of policy experimentation and institutional change. Table 3 shows the empirical material gathered.

Table 3
Empirical material used in the study.

Phase I: May - June 2017	**Unstructured interviews & innovation history workshop for scoping analysis**
Interviews of 7 experts	Business: 2 (I1, I6) University: 1 (I2) Innovation agency: 2 (I3, I5) Research institute: 1 (I4) Ministry: 1 (I7)
Innovation history workshop involving 9 experts	Business: 2 University: 1 Innovation agency: 3 Research institute: 1 Ministry: 1 Transport agency: 1
Phase II: January - May 2019	**Semi-structured interviews for case study construction**
Interview of 17 experts in 16 interviews	Business: 3 (I16, I19, I20) Innovation intermediary: 2 (I15, I22) Ministry: 3 (I9, I10) Transport agency: 3 (I11, I12, I18) Network organisation: 3 (I13, I17, I21) Think tank: 1 (I8) Public transport provider: 1 (I14) Innovation agency: 1 (I23)

The first seven face-to-face interviews in 2017 were unstructured and utilised to scope the development and central issues in the Finnish mobility transition. The 4-hour innovation history workshop presented an initial timeline of the events and sought feedback and elaboration from its nine participants. The interviews and workshop were conducted in connection to collaborative work with the first author and the Finnish Funding Agency for Innovation Tekes (now Business Finland) through the Transformative Innovation Policy Consortium (www.tipconsortium.net). The interviews and workshop discussions were recorded and partially transcribed.

The second round of sixteen semi-structured interviews was conducted by the first author following an early version of the analytical dimensions: policy experimentation and institutional change. The interviewees were asked to describe: (a) the most significant events and influencing factors on the development of MaaS; (b) related institutional change and public governance; (c) the role of public governance experiments / experimental culture; (d) the transport service act and administrative changes in the sector of transport and communications; (e) the role of the administrative sector of the Ministry of Economic Affairs and Employment and the innovation funding agency Business Finland; and (f) the current status of MaaS and its future potential. In addition, supplementary questions were asked based on the interviewees' expertise. The interviews were conducted in 2019, face-to-face (12 interviews) or over the phone (4 interviews), and with different people from the first phase. The interviews were recorded and transcribed verbatim and analysed by the first author to create a detailed case narrative. The narrative was then sent to all the interviewees for fact checking. Subsequently, the narrative was coded in NVivo for the purpose of the analysis.

5. Development of MaaS in Finland

MaaS in Finland embraces an idea of freedom of mobility, to ease people's lives via providing novel mobility solutions independent of car ownership, by combining public and private providers. It describes a vision of future mobility that is greenhouse gas emissions free, affordable, economically efficient, time-efficient, freeing up the urban space, and ending road fatalities (Suikkanen and Hietanen, 2017). MaaS in Finland is largely pursued from a market-driven perspective, with environmental drivers also contributing (I10, I12, I17, I21).[1]

The development of MaaS initially focused on urban areas. More recently, rural MaaS has gained interest to generate costs savings to the public sector, coupled with improved and less expensive services for private consumers (I15, I20, I22). MaaS, thus, links to the reduced availability of public funds, a lowered public transport service level, and environmental and security challenges (I21).

At the time of the study, regarding new MaaS services, Maas Global was the only fully operational MaaS operator company in Finland, while another start-up, Kyyti, functioned as a platform and solution provider. The telecommunications operator TeliaSonera had also run MaaS pilots. There had been associated business developments, for example, by a banking and car insurance company OP. Generally, MaaS was still in an early phase.

5.1. Chronological overview

5.1.1. Early developments towards intelligent transport

The development of MaaS links to how transport and communications policy have been made in Finland since the mid-1990s. Maas falls within the remit of the Ministry of Transport and Communications (MTC), where ministers and high-level civil servants have created visionary policy strategies on intelligent transport systems.

In 2004, the MTC launched the Intelligent Transport Systems Finland (ITS Finland) as an open forum for the collaboration of companies, researchers and the public administration (ITS-Finland, 2019a; I21). In 2006, ITS Finland became a non-profit association, a public-private network partially funded by the MTC, aiming to "increase the safety, security and efficiency of the transportation systems and help to create more traffic free zones in cities" (ITS-Finland, 2019b). This association has been described as a 'primus motor' in advancing MaaS. Its former CEO, Sampo Hietanen, had the idea to compare the transport sector to telecommunications in terms of future opportunities: using an operator that connects to customers by offering different 'packages' to consumers (I1, I6, I8, I2, I10, I17, I19).

From 2007, the MTC began developing new transport policy with a new Permanent Secretary Harri Pursiainen and Minister Anu Vehviläinen (Centre Party). A new strategy, *Transport 2030*, described climate change as the most significant challenge and proposed means to address it, such as stopping the fragmentation of urban structures and growth in the use of private cars (MTC, 2007).

One of the outcomes was the *Strategy for Intelligent Transport* which was published in 2009 in response to landscape pressures such as climate change, globalisation and limited finances (MTC, 2009). It acknowledged the need to renew transport services, containing ideas around public-private collaboration, technology neutrality and user orientation (I10). It further demonstrated that transport was perceived in the ministry from a different viewpoint than before (I19).

In 2010, agencies for aviation, road, rail and marine transport were merged into new multimodal transport agencies, the Transport Agency and the Transport Safety Agency (Trafi), enabling "more coordinated planning of different transport modes with potential benefits to low carbon transition" (Kivimaa and Temmes, 2016, p. 141; I2, I19). This change was associated with a shift of attention from building roads to solving problems first, intelligent transport systems to make smarter solutions, and user orientation (I17, I19). We regard this as the **first institutional change** supporting MaaS.

A sequence of strategy documents followed. In 2011, the MTC published the *Transport Revolution Programme*, aimed "at developing a new mind-set for urban and transport planning and policies and policy implementation" (MTC, 2011, p. 1; I19). It noted that transport and logistics would be approached as a service (I7) and emphasised a new way of thinking, administrative renewal, experimental projects, and piloting new service concepts (Sitra, 2019). This new mindset was also visible in the government's *Transport Policy Report to the Parliament* published in April 2012, which describes a 'serving transport system' (MTC, 2012a).

5.1.2. Active vision formation for MaaS

After Merja Kyllönen (Left Alliance) was appointed as Minister, in 2012, she established a New Transport Policy Club (NTPC) to renew transport policy and respond to the challenges of emissions, automatisation and servitisation (I13). We regard the NTPC as the **first policy experiment,** one outside the boundaries of established innovation policy of the time (i.e. **type 2,** see Section 5.2 for details). Several interviewees mention the influence of the NTPC for the development of MaaS (I1, I7, I10, I13, I21, WS). A key event was a meeting in 2013, where Sampo Hietanen, from ITS Finland, presented on MaaS. It was then when a leading civil servant, Minna Kivimäki, realised that they need to renew the whole transport policy: "This can be described as the moment when MaaS truly began progressing" (I1).

The conceptualisation of MaaS progressed in 2014, when Sonja Heikkila published an MSc thesis, commissioned by the Helsinki City Planning Department, *Mobility as a Service - A Proposal for Action for the Public Administration, Case Helsinki* (Heikkilä, 2014; WS). Subsequently, the largest Finnish newspaper published an article referring to the thesis (Aalto, 2014), resulting in high attention, with Ms. Heikkila delivering hundreds of talks internationally (I1, I8, I13, I15, I16). Soon after, the MTC launched the idea of MaaS, with a supportive animation in

[1] I1-I23 refer to the interviews conducted. See Appendix 1 for the full list of interviews.

YouTube (Fig. 1).

Also, in 2014, the MTC established the Traffic Lab to enable new market creation for intelligent transport services. We regard the Traffic Lab as the **second policy experiment,** again representing **type 2** by being a rather radical policy intervention outside the boundaries of existing innovation policy (see Section 5.2). This second experiment enabled the continuation of 30–40 experiments initiated under the NTPC, being transferred to the Traffic Lab when the club ended in 2014 (I13).

5.1.3. *New business model creation*

Initially in the national innovation agency Tekes, MaaS was a small, informal initiative, a campaign to activate new companies to start market disruption, testing and developing new technologies and services (I3, I5). However, in 2015, MaaS support in Tekes became more formal when the innovation agency launched a two-stage call to fund MaaS operators (I3, I5, I16), driven by collaboration between the MTC and Tekes (WS). Maas businesses regarded this funding programme instrumental (I6, I15, I16), while some Tekes officials called it experimental, being initiated bottom-up and by-passing the usual bureaucratic process of programme-setting in the organisation (WS). We regard Tekes's MaaS activities as the **third policy experiment,** in this case **type 1,** conducted within the boundaries of existing innovation policy but applying some adjustments compared to Tekes's standard programme activity (see Section 5.2).

ITS Finland asked different companies for their interest to establish an operator, and 24 actors (Siemens, Ericsson, Uber, HSL, TeliaSonera, Elisa, etc.) agreed to fund the preparation of a business plan; based on which an ecosystem of companies was formed (I1, I19). In 2016, Sampo Hietanen resigned from ITS Finland and became the CEO of a new company MaaS Global, the first to develop MaaS operator services (I6). Its establishment as a front-runner company has been one of the key events in the Finnish MaaS trajectory (I6, I13, I16, I19). MaaS Global received funding from Tekes (I5, I6, I19), and investments from some car industry companies (I19).

5.1.4. *High-level policy support and entrepreneurial experiments*

The timing of MaaS developments fitted with a new government term and programme, formed by the Centre Party, the National Coalition Party and the True Finns, in 2015. While the government programme was not ambitious in terms of environmental sustainability; it highlighted digitalisation, new services and experimental culture (I10, I8, I11, I12). The programme also explicitly mentioned MaaS and allowed the advancement of major regulatory change (I10). In addition, the MTC's new Minister Anne Berner (Centre Party) was personally committed to taking MaaS forward (I10, I12, I16), as others before her.

In 2016, the MTC had an organisational change, where the separate transport and communications departments were merged and divided into four new departments: ministerial governance, networks, data, and services; and these comprised all transport modes and communications (I10, I19). The main driver for this reorganisation was a change in thinking in the ministry towards more holistic policy (I21). We regard this as the **second institutional change**, preceded by learning from the policy experiments.

Entrepreneurial pilots began in 2016. They were carried out by a telecommunications company TeliaSonera, MaaS Global and some research consortia. The first pilots were significant, providing learning and enabling the development of new business ecosystems (I18). Also, in 2016, an independent organisation 'MaaS Alliance' was established in Europe, hosted by ERTICO ITS Europe, and influenced by Finnish stakeholders from public and private sectors (I17).

5.1.5. *Major institutional change and merging transport and innovation policy*

In 2017, the Ministry of Economic Affairs and Employment (MEAE) began coordinating the development of the *National Growth Programme for the Transport Sector 2018–2022* (MEAE, 2018). Multiple actors were involved, with an aim to align transport policy with innovation policy more closely (I21) and with MaaS as one of six growth areas (I9, I10).

More importantly, new framework legislation was created in 2017, the Transport Service Act. We consider this as the **third institutional change**. Its idea was to proactively support new transport services and innovation through significant regulatory change. The Act was influenced by developments in intelligent transport systems and issues explored in the policy experiments and was prompted by discussions on MaaS and the need to open access to information and ticket sales to third parties (I6, I9 I11, I12, I15). Several interviewees regarded this as a significant step in the development of MaaS (I2, I8, I10, I12, I13, I16,

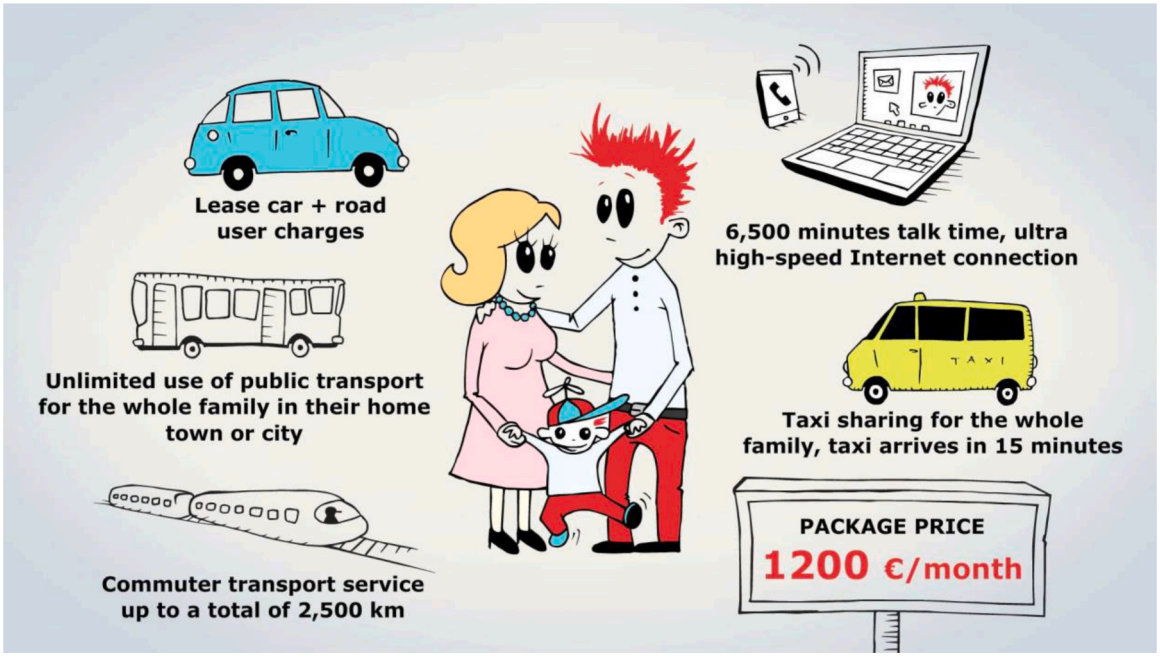

Fig. 1. Example picture of MTC launch of MaaS (Source: MTC video animation of MaaS).

I19, I20, I21). "Certainly, the preparation of the Transport Service Act is the largest [supporting factor from the public governance side], both as an enabler and a clear signal that there is willingness to support this development" (I18).

The change in legislation was followed by further business developments. One area of attention has been rural MaaS, with the Kyyti Group as a key actor. In November 2018, Business Finland awarded subordinated loans as part of its new Growth Motor Funding, in total 28.4 million to five different companies, two of these related to MaaS (Business-Finland, 2018), enabling the further development of the MaaS ecosystem (I20, I22). Business Finland regards this a globally innovative policy instrument, with a specific vision, goals and a stepwise procedure, and has proposed to the government that this instrument is continued (I23). We regard this as the **fourth policy experiment,** which was within the boundaries of existing innovation policy and thus classified as **type 1** (see Section 5.2).

In 2019, a climate and environmental unit was established to MTC's network department and the administrative agencies were reorganised (I10). The Transport Agency became the Finnish Transport Infrastructure Agency, responsible for road, rail and marine transport and integrating transport and land use (Väylä, 2018). More importantly, a new integrated Transport and Communications Agency (Traficom) was created (Traficom, 2018). We regard this as the **fourth institutional change**.

Fig. 2 summarises the key events in the formation of the MaaS niche in Finland.

5.2. Policy experimentation pertaining to MaaS

In the development of MaaS, we identified four instances of policy experimentation, each in its own way crucial. Two of these pertained to type 1 policy experimentation, i.e. as policy interventions of a more incremental nature and within the boundaries of existing innovation policy: Tekes's MaaS campaign and funding programme in 2014–2015, and Business Finland's (a merger of Tekes and Finpro) growth motor funding instrument in 2018–2019. The other two represent type 2 policy experimentation, i.e. policy interventions of a more radical nature that arose outside the boundaries of existing innovation policy: The New Transport Policy Club (NTPC) in 2012–2014 and the Traffic Lab in 2014–2016. Table 4 shows the key characteristics of these experiments. In this section, we analyse these policy experiments in terms of their attention to learning and their influence on the development of MaaS. We will also consider the other processes of strategic niche management in sustainability transitions: articulation of expectations and visions, and networking.

Five interviewees mentioned the important role of the experimental culture in Finland which has changed how the administration deals with uncertainty. However, many experiments conducted are still small and it has been uncertain how to derive more permanent change from experimentation.

5.2.1. First policy experiment: new transport policy club

Minister Kyllönen established the NTPC for a 2.5-year period, to meet 2–4 times per year (MTC, 2012b) to renew transport policy and respond to the challenges of emissions, automatisation and servitisation. In the MTC it was thought that they "need something more to help us implement our strategy" (I7). The NTPC aimed to generate cognitive and normative learning (with emphasis on the latter) about future mobility systems options and how they are shaped by changing perspectives and priorities. It discussed how to renew the tightly regulated structures in the transport sector, whether transport and associated services can be reorganised, and how to enable such change.

The NTPC operated akin to a transition arena, inviting actors across public and private sectors. Rather than asking organisations to send their representatives, the participants to the NTPC were handpicked to include visionary people from the public, private and research sectors, not just limited to the transport sector, and the Minister herself. This network of actors shared new information and insights between themselves.

The expectation dynamics in the NTPC related to moving from traditional infrastructure and cost-based transport policy to innovation which responds to changing landscape pressures: environment, security, finance, automation. It aimed at creating a common vision and goals. Moreover, the NTPC was where the idea of MaaS was first expressed and

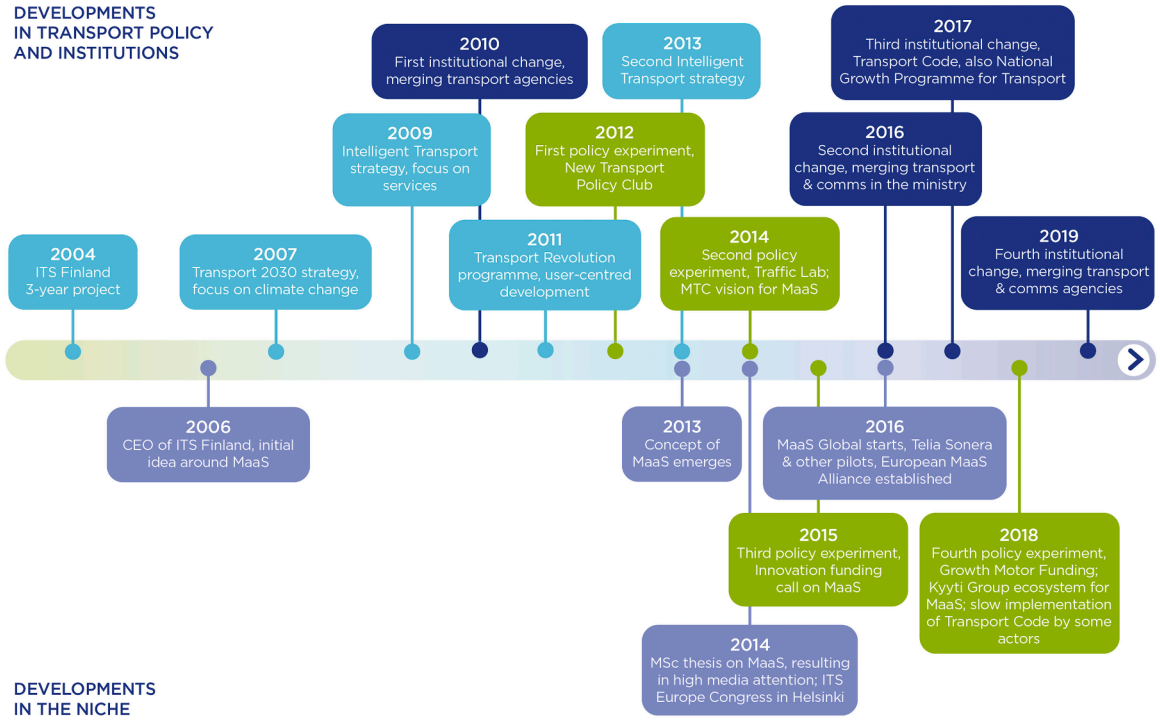

Fig. 2. MaaS timeline (2004–2019): from early development towards intelligent transport systems to the formation of the mobility-as-a-service.

Table 4
Key characteristics of the four instances of policy experimentation.

	New Transport Policy Club 2012–2014	Traffic Lab 2014–2015 (made permanent after)	Tekes MaaS programme 2014–2015	Growth motor funding 2018–2019
Intention	Renew transport policy (unlearning, destabilising)	Experiment in connection to intelligent transport services via collaboration between the public sector, companies and research (niche development)	New business model construction for MaaS (niche development)	Supporting new business ecosystems (niche development)
Temporary nature	Set for 2 years	Set for 2 years but later made permanent (institutionalised)	Initial discussions followed by an innovation programme of 1 year	Initially June 2018-March 2019; continuation uncertain
Initiator (public sector); other actors	MTC; A group of visionary people from the public, private and research sectors, not just limited to transport	MTC; The public sector, companies and research sector coming together to collaborate (with facilitation)	Tekes, in dialogue with MTC; Round tables with different actor groups (e.g. taxi drivers, cities, businesses), followed by funded consortia for business model development	Business Finland; Business ecosystems funded
Experimental approach	Type 2: A kind of 'transition arena' inviting visionary people and enabling thinking beyond the transport sector, with minister and high-level civil servants as recipients of the insights gained	Type 2: Umbrella for public-private experimentation to enable new market creation for intelligent transport services	Type 1: Emerging from informal dialogue with civil servants at Tekes and MTC; round tables with different actor groups; Tekes as thought leader; bypassing usual bureaucratic processes in setting up the programme	Type 1: Focus on business ecosystem creation instead of traditional consortia or individual business funding; lending money for ecosystems expansion

kick-started by a new collaborative network.

5.2.2. Second policy experiment: traffic lab

In 2014, the MTC established the Traffic Lab to enable new market creation for intelligent transport services and to develop ideas how to implement road-charging systems. The Lab was initially an experimental, fixed-term project, operating as an umbrella for digital service initiatives, and set to end in 2015. It aimed to experiment in connection to intelligent transport services via collaboration between the public sector, companies and research (MTC, 2014). "It was a new way of operating in collaboration, so that there is facilitation, and the government authority comes closer to the company interface…to enable that from the perspective of mutual benefit, we can communicate, facilitate workshops and seminars and such that promote the advancement of this thing" (I12). The Lab was effectively seen as new innovation policy but located within the transport policy domain.

The Lab generated cognitive learning via experimentation with data-based transport pricing and other technical solutions, but also normative learning about new ways of doing things. Initially, the Lab was data driven, by generating (any) data related to transportation as open-ended knowledge production, which was seen less conducive for market creation. Learning was strengthened by aggregating knowledge from multiple experiments undertaken under the umbrella of the Lab. In addition to experimental projects, learning was also created and shared through communication and facilitation by the Lab's coordinators. It included working groups, for example, on service design, user behaviour, and regulatory change needed for smart transportation.

The Lab acted as a protected space for experimentation, with the public sector co-experimenting and networking with companies and the research sector. By 2018, the network had grown to 2000 people and 42 network organisations. The innovation and transport agencies have collaborated in the Lab; some of the Lab's projects received funding or low-interest loans from Tekes (later Business Finland). The Lab has created new kind of interaction between government and city officials and companies, resulting in joint public-private experiments and the emergence of a new ecosystem of actors. However, an interviewee regarded it also as a rather closed network from the perspective of those not taking part in experimenting in the context of the Lab.

The expectations around the Lab have dynamically changed during its existence. People did not initially address MaaS, but the Lab developed into a forum for advancing a variety of experiments, on MaaS and beyond. These experiments encouraged innovation, created a better understanding of ongoing projects and the future of passenger and goods transport, and activated and grew the network around it.

The Lab has connected to landscape pressures related to climate change, digitalisation, and international business. It has raised and enabled new issues, developing insights on the future of transport. Government actors have aimed to hear about companies' wishes and needs. Although the MaaS vision arose elsewhere, the innovation agency created its MaaS team because of participating in the Lab. Moreover, in updating the operation of the Lab, MaaS has become part of the future vision of transport in Finland.

5.2.3. Third policy experiment: Tekes MaaS programme

Tekes's MaaS programme started in 2014 with a small, informal campaign with the Ministry of Transport and Communications (MTC) to begin activating companies in new service creation. The campaign generated normative learning in roundtables that brought together different actors to discuss, for example, the needs of cities and consumers with respect to service designs. This was followed by a two-stage call to fund MaaS operators, driven by existing collaboration between the MTC and Tekes. The first stage funded circa 20 projects, with little preselection, to create cognitive learning by planning real MaaS pilots and co-designing them with potential partners – also creating new networks. In the second stage, Tekes designed a more specific call, asking for an idea of a test bed, good collaborators, external investors, and some connections to capacity builders.

The MaaS programme generated learning on how to start MaaS businesses. However, the activities were not formally evaluated, and long-term learning was lacking – due to a combination of an organisational change at Tekes, key people changing positions, and the unconventional set-up not following the typical Tekes procedure for evaluation. Thus, in a sense the informal nature of policy experimentation worked against more systematic learning.

However, the MaaS programme created new business networks, i.e. ecosystems, around MaaS. In addition, it improved communication between the MTC, Tekes, the Ministry of Employment and Economy and ITS Finland, i.e. forming deeper networking for niche building.

The aim behind the MaaS programme and associated project funding was to create a common understanding for vision creation. "Tekes organised, so that they then had a big role, even as a thought leader, to make sure it advanced" (I6). Many companies regarded the programme instrumental for MaaS niche creation.

5.2.4. Fourth policy experiment: growth motor funding

Growth motor funding was created when the government awarded Business Finland an additional 60-million-Euro budget to be used for company loans during 2018–2019. The funding is an innovative instrument, a new type of subordinated loan, allocated to new business ecosystems via a competitive procurement procedure. It aimed for value

creation both for the funded ecosystem companies and actors more broadly, such as the customers of new solutions – within the principles of sustainable development. While the decision and evaluation process are the same for the applicants, the design of the lending sequence is case specific.

Growth motor funding has been less important for learning and expectation dynamics, at least in the short-term, than the other policy experiments. However, it has been influential in making the MaaS business networks more robust and taking the niche forward in enabling market diffusion. In addition, it has been described as critical for the Kyyti Group that received a loan of 5 million euros.

Table 5 summarises the immediate effects of the policy experiments on MaaS niche development and transformative change in the transport sector.

5.3. Interaction between policy experimentation and institutional change

In this section we briefly analyse the interactions between policy experimentation and institutional change in the development of MaaS in Finland (see Table 6).

The interviews provide evidence that the *organisational changes* carried out in the MTC's administration in 2010 and 2016 were aimed to support systemic change in the transport sector, thereby supporting MaaS. In essence, civil servants were pushed towards an organisational culture more open to experimentation and collaboration with innovation agencies. This directly facilitated type 2 policy experimentation initiated by the MTC and inspired type 1 policy experimentation initiated by Tekes, during 2012–2015, which led to increased learning on the opportunities and barriers of a service- and data-based transport system.

Required *regulatory change*, later enacted through the Transport Service Act, was discussed in type 2 policy experiments, leading to normative learning. In addition, one senior government official was active in both the NTPC and the advancement of the Transport Service Act. Furthermore, the pilots in the first type 1 policy experiment illustrated the need for regulatory driven market creation. While the Tekes MaaS programme tried to generate business from MaaS bottom-up, it became clear that this was not sufficient, and regulatory change through the Transport Service Act was needed. In turn, the Act was remarked to be significant in allowing new experimentation on the ground and attracting investors.

6. Discussion

MaaS thinking as operationalised in Finland has attracted much interest internationally. Hence, in the following we discuss the key influencing factors. We, first, focus on the interplay between institutional change and policy experimentation before reflecting on the interconnections more broadly, particularly in relation to transitions thinking and the broader policy mix influencing transitions.

Table 6
Key interactions between policy experimentation and institutional change in MaaS development in Finland.

	Organisational change at MTC and its agencies	Regulatory change via the Transport Service Act
Type 1 policy experimentation (Tekes MaaS Programme, BF growth motor funding)	Type 1 policy experimentation has increased collaboration between transport sector agencies and the innovation agency, and vice versa.	Cognitive learning from type 1 policy experimentation illustrated problems with current legislation and the need for regulation driving market creation.
Type 2 policy experimentation (New Transport Policy Club, Traffic Lab)	Organisational changes aimed for systemic approach and encouraged type 2 policy experimentation in MTC's administrative sector.	Normative learning from type 2 policy experimentation via discussions on regulatory needs drove institutional change.

6.1. Interplay between institutional change and policy experimentation in the development of MaaS in Finland

In Finland, the public sector at the national level has taken an active role in the conceptualisation and facilitation of MaaS, systematically enabled by institutional change. Part of this significant interest is explained by the declining mobile phone design and manufacturing business, built around Nokia. There has been a merger of two previously separate policy domains, communications and transport, into a new policy domain of intelligent transport and communication systems. Moreover, interaction with innovation policy has been crucial, and increasingly sought. We want to stress four key points for understanding the interplay between institutional change and policy experimentation in the Finnish MaaS context.

First, publicly funded organisations, including the Ministry of Transport and Communications (MTC), Business Finland and the public-private network ITS Finland, have been instrumental from the early stages of niche development. The MTC has perceived the traditional transport-mode and infrastructure-orientated governance as a barrier and opened discussions with other actors and ministries, such as the Ministry of Economic Affairs and Employment in charge of innovation policy. Underlying this has been the political support received from several ministers from different parties, including the Left Alliance, the National Coalition Party and the Centre Party. In addition, experimental culture has grown strongly in the administrative sector, which has

Table 5
Policy experiments and their transition effects.

Transition effects of policy experiments	New Transport Policy Club (type 2)	Traffic Lab (type 2)	Tekes MaaS programme (type 1)	BF Growth motor funding (type 1)
Role in MaaS development	MaaS presented as an idea, picked up by a high-level civil servant, and developed into a vision to be advanced at the MTC	After NTPC ended, 30–40 experiments were placed in the Traffic Lab, widening its scope to include MaaS	Instrumental funding to begin developing ideas for MaaS business models in practice	Instrumental funding to scale up business ecosystems for MaaS (also for other purposes as not MaaS specific)
Learning	Emphasis on normative learning about future mobility options and perspectives	Emphasis on cognitive learning via aggregation of technical experiments	Normative learning via roundtables and cognitive learning from business model pilots, but lack of formal evaluation	Not known
Networking	'Transition arena' with broad networking and vision building across sectors	Created new kind of public-private networks, and strengthened Tekes-MTC collaboration	New networks created around MaaS business models, improved public sector collaboration	Increased robustness of MaaS business networks
Expectation dynamics	Aiming towards a common vision for future transport and new innovation-based transport policy	Changing expectation dynamics around the future of transport	Aiming to create common understanding for the MaaS vision, Tekes as thought leader	Contribution to MaaS viability, but instrument not focused solely on transport

encouraged civil servants to try new things even with the risk of failure. Yet, the Finnish turn towards experimentalist governance is less specific than that suggested by Sabel and Zeitlin (2012) and follows more loosely the idea of experimental culture. The above have meant that institutional barriers were removed sooner and MaaS developed faster than even in Sweden, another leading country in MaaS (cf. Smith et al., 2018a, 2018b).

Second, the first institutional change in the MaaS case, merging policymaking on different transport modes, enabled policy experimentation, creating a 'whole-system' perspective on mobility. It also gave civil servants a leeway to experiment and 'take risks'. As a result, the New Transport Policy Club and the Traffic Lab were established, both representing type 2 experiments outside established innovation policy. The former was akin to a transition arena (cf. Loorbach et al., 2015), joining frontrunners to develop a shared direction and vision for the mobility transition and produce learning about how policy should change. It was a space for cognitive and normative learning (cf. McFadgen and Huitema, 2017) about future mobility system options and how they are shaped by changing perspectives and priorities. The latter generated cognitive learning about how new technologies are likely to influence market disruption. The learning from these policy experiments revealed that it is possible to organise mobility around novel services, that public-private collaboration and new business ecosystems are important, and that the new services require institutional and policy change to remove existing barriers.

Third, both type 1 and type 2 policy experimentation influencing MaaS can be described as 'informal' (cf. Ansell and Bartenberger, 2016), meaning that they did not generate formal evaluation-based learning. Yet, they created informal cognitive and normative learning that, coupled with the development of MaaS businesses, influenced further institutional changes. These included the creation of holistic transport and communications governance and the major renewal of transport sector regulations. Thus, we found, contrary to Mei and Liu (2014), that policy experiments can substantially contribute to institutional change.

Fourth, we did not only observe change in formal but also in informal institutions evidenced in new working cultures which are more attuned to experimenting and consider transport policy from a new mindset. This indirectly supported later formal institutional change which usually is not an easy endeavour and frequently faces opposition. Moreover, our case shows that policy experimentation can provide the temporary space and more flexible conditions than traditional policy instruments and processes, to generate policy learning before and intertwined with changing informal and formal institutions. Indeed, in the Finnish MaaS case this widespread learning seems to have supported politicians and civil servants in implementing the institutional (regulatory) change despite strong opposition from some regime actors, such as taxis and public transport operators.

6.2. *Reflections on policy experimentation, institutional change and broader mix of policies from the perspective of sustainability transitions*

Our empirical findings show the complex interplay between policy experimentation and formal institutional change, indicated also in earlier literature on policy mobility (cf. Affolderbach and Schulz, 2016). In this section, we want to embed this interplay into the context of the overall mix of policies influencing transitions. This is to illustrate that neither policy experimentation nor institutional change can be singled out as key means of governance for transitions. Rather they co-exist and co-influence at any time with the current set of policy goals, strategies, instruments and processes that interact in the real world and can be called policy mixes (Flanagan et al., 2011; Rogge and Reichardt, 2016). These policy mixes influence and are influenced by transition dynamics (Edmonson et al. 2019).

We argue based on our empirical findings that policy experiments can be viewed as elements of policy mixes for sustainability transitions, with close connections to institutional change. This is a new contribution to the emerging policy mix literature (cf. Kern et al., 2019), which has scarcely addressed experimentation and institutional change (except for Edmonson et al. (2019) examining the institutional effects of policy mixes; and the broad similarities in how change processes are described to contain elements of layering, drift and conversion (cf. Kern and Howlett, 2009)). The findings of our analysis make explicit that policy experimentation can create, in minimum, short-term changes to policy mixes and it can support the cross-over of administrative policy domains in creating transformative policy mixes. Further, changes in formal institutions may have significant implications on the nature of the policy mix.

With such a broader perspective, in the following, we offer four reflections on the resulting dynamic interconnections between policy experimentation, formal institutional change and the policy mixes influencing transitions. Fig. 3 illustrates this dynamic in the context of MaaS in Finland. Our findings show that while policy experimentation and institutional change played a prominent role, also the set of strategies and programmes constituting the broader policy mix was important.

First, the MaaS case shows the overall dynamics of strategic niche management: visioning, learning and network formation (cf. van der Laak et al., 2007; Schot and Geels, 2008) which benefitted policy experimentation. Non-state actors took part in policy experimentation, businesses and research actors being most common (while experimentation could have been more inclusive to more vulnerable or marginal groups of population (cf. Chataway et al., 2014)). The specific idea of MaaS was presented by an innovation champion in one of the Transport Policy Club meetings, and soon developed into a vision advocated by the ministry, also endorsed in the Government Programme. This support from the public sector became visible in the overall national-level policy mix, including transport policy strategies, innovation funding and different forms of policy experimentation across policy domains.

Second, the institutional change we detected represents 'gradual transformation', where incremental processes of change have led to discontinuity in institutions (Streeck and Thelen, 2005). When institutional discontinuity is needed to enable socio-technical transitions, this kind of 'gradual transformation' appears superior to 'breakdown and replacement', whereas the latter may only occur when policymakers have failed to react early and must respond to abrupt changes in the system. Yet, we also detect 'layering' of institutional rules as, despite substantial re-regulation by introducing new rules for opening electronic data and ticketing interfaces, many old transport sector rules regarding private and public transport remained in place. While the Transport Service Act represents a destabilising policy to support transitions, the layering shows that further 'creative destruction' in the mix of institutions and policies affecting the transport sector is still essential (cf. Kivimaa and Kern, 2016).

Third, the MaaS case illustrates how the overall policy mix evolves over time, not only by the mechanisms of layering, drift and conversion of policy goals and policy instruments, but also by policy experimentation. Arguably, the immediate impact of policy experimentation on the policy mix has been relatively short-term, but our findings indicate the potential for long-term implications on policy and institutional change through learning. The MaaS case also shows that this change can occur via two routes: (1) by institutionalising a policy experiment as part of the more permanent policy mix (e.g. the Traffic Lab) and (2) by actors learning about the needs to change the policy mix to further promote niche development (e.g. the Transport Service Act). The case also emphasises that the impact of transformative policy mixes happens gradually, rather than in a given moment, and therefore, the directionality and consistency of the policy mix across policy domains and over time is crucial.

Fourth, via Bernstein and Hoffmann's (2018) three mechanisms of how experimentation may instigate transitions, we can observe different types of effects from policy experimentation to the Finnish mobility transition. The institutionalisation of the Traffic Lab and the changing

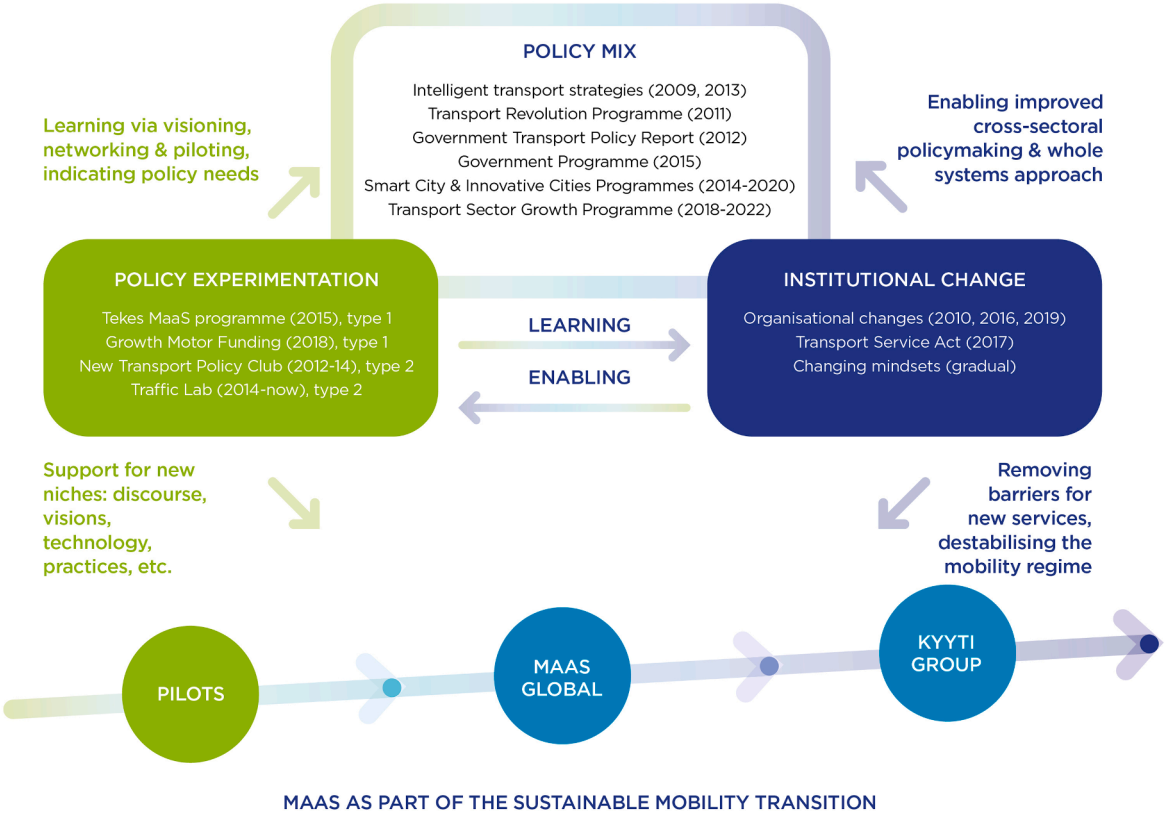

Fig. 3. Mobility as a service in Finland: policy experimentation and institutional change in the context of the policy mix and niche development.

mindsets regarding transport policy have catalysed direct and indirect normative change. The mobilisation of human and financial resources in a range of policy experiments have built capacity to act differently. And, the New Transport Policy Club and the public-private network ITS Finland have stimulated coalition building. These changes can also be seen via the lens of informal institutional change.

Finally, however, following Huitema and McFadgen (2018), we want to note that it is not self-evident that policy experimentation leads to changes in institutions or advances transitions. Policy experimentation may generate learning that indicates that a certain change is not desirable. Alternatively, learning from policy experimentation may be cognitive and not useful on its own, when also normative learning about societal changes is needed. Even if policy experimentation demonstrates viable policy alternatives, the political dynamics and resistance may prevent changing the established policy mix. Indeed, some politicians may use policy experimentation as a smoke screen to avoid more permanent changes to the policy mix. Therefore, for policy experimentation to result in more permanent changes in the policy mix and formal institutions, supportive innovation champions and transition intermediaries (cf. Kivimaa et al., 2019) may be necessary. The Finnish MaaS case shows that the leading civil servants' and ministers' role has been crucial for transformative change.

To end, it must be noted that Finland is a special case in many respects. First, the case showed a relatively long history of integrated policymaking across the policy domains of transport and communications. This long history enabled the policy changes and reorientation in thinking in the past six years. Second, policymaking across administrative sectors has a long history in Finland, and civil servants are familiar with engaging in cross-sector strategy formation in an informal manner. Third, Finland does not have a major car manufacturing industry, but instead a strong telecommunications sector which has created a progressive position in advancing intelligent transport systems. Thus, the broader learnings from this case must be adjusted to country-specific contexts, more as a guide to how, in each context, policy experimentation can be used to contribute to innovation policy and the institutional and policy mix changes needed for sustainability transitions. Yet, this analysis has enabled us to generate novel, empirically valid theory (Eisenhardt, 1989) on the connections between policy experimentation, institutional change and transitions.

7. Concluding remarks

This article provides evidence that policy experimentation can accelerate new niche development in sustainability transitions alongside changes stimulated by more typical policy strategies and instruments. Cognitive and normative learning generated via policy experimentation can make essential contributions to institutional change, while it is by no means certain. Even when experimentation is disruptive, institutional change can take the form of gradual transformation, in which multiple incremental changes lead to discontinuity in institutions that support sustainability transitions. At the same time, institutional change is likely to be vital in creating a conducive context where policy experimentation supporting sustainability transitions can happen and become influential. There is, thus, dynamic interplay between the two elements and the developing transition.

Based on the empirical study of MaaS in Finland, we suggest that policy experimentation is more likely to lead to more stable and substantial changes in institutions when there is political backing and support to use the cognitive and normative learning from experimentation to form new policies and changing organisational settings. In addition, broad acceptance from the network of actors associated with a sustainability niche enables the eventual institutionalisation of experimental policies, even against regime resistance. Moreover, our case shows that policy experiments' broader influence and formal institutional change are more likely when the socio-technical system is already changing, and when incumbent actors have begun to question their

assumptions, beliefs and values and being more explorative about how to address global sustainability challenges.

It is too early to say how the policy experiments and institutional changes observed in this case will influence the Finnish mobility transition in the long term, especially in the changing conditions created by the Covid-19 pandemic and intensifying climate crisis, despite creating favourable conditions for governing a sustainability transition. How the transition will unfold also depends on the broader cross-sectoral and multi-level policy mix, including the policies implemented by cities and towns, and importantly the changes in the everyday practices of businesses and citizens using transport services.

Author statement file

Paula Kivimaa initiated the idea for the paper and its conceptualization. She conducted data curation, formal analysis, investigation, methodology, visualisation and wrote the original and revised manuscript. She also contributed to funding acquisition and conducted project administration.

Karoline Rogge contributed to conceptualisation, visualisation, writing and editing the original and revised manuscripts, and funding acquisition.

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Declaration of Competing Interest

The authors have no competing interests

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Appendix 1: List of interviewees

I1 Sampo Hietanen, CEO, MaaS Global

I2 Armi Temmes, Professor of Practice, Aalto University Business School

I3 Christopher Palmberg, Development Manager, Innovation Agency Tekes / Business Finland

I4 Nilf-Olof Nylund, Research Professor, VTT Technical Research Centre

I5 anonymous, Innovation Agency Tekes

I6 Satu Kantola, MaaS Global

I7 anonymous, Ministry of Transport and Communications

I8 Henrik Suikkanen, Senior Consultant, Demos Helsinki

I9 Kirsti Vilén, Ministerial Advisor & Antti Eskola, Commercial Councellor, Ministry of Economic Affairs and Employment

I10 Saara Reinimäki, Senior Specialist, Ministry of Transport and Communications

I11 anonymous, Traficom

I12 Juha Kenraali, Data Manager, Traficom

I13 Marko Forsblom, CEO, ITS Finland

I14 anonymous, HSL Helsinki Region Transport

I15 Sami Sahala, ITS Chief Advisor, Forum Virium, City of Helsinki

I16 Sonja Heikkilä, Programme Director of Mobility Services, OP Financial Group

I17 Piia Karjalainen, Secretary General, MaaS Alliance

I18 anymous, Traficom

I19 Krista Huhtala-Jenks, Head of Ecosystem and Sustainability, MaaS Global

I20 Pekka Möttö, CEO, Kyyti Group

I21 Laura Eiro, Programme Manager, IST Finland

I22 Heikki Sorasahi, Specialist, Finnish Innovation Agency Sitra

I23 anonymous, Business Finland

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